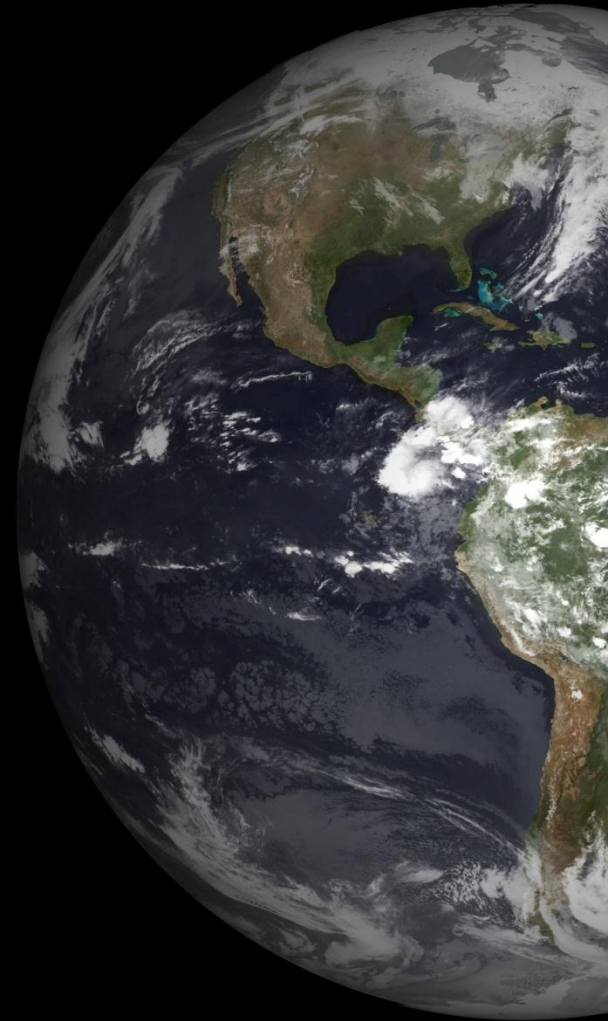


An Overview of the GOES-R Program



Greg Mandt
GOES-R System Program Director

7th GOES Users' Conference
October 20, 2011



CONGRESS CUTS FUNDING
FOR NOAA HURRICANE-
WATCHING SATELLITES...

RELAX. IT'S
GOOD FOR THE
ECONOMY!

USA

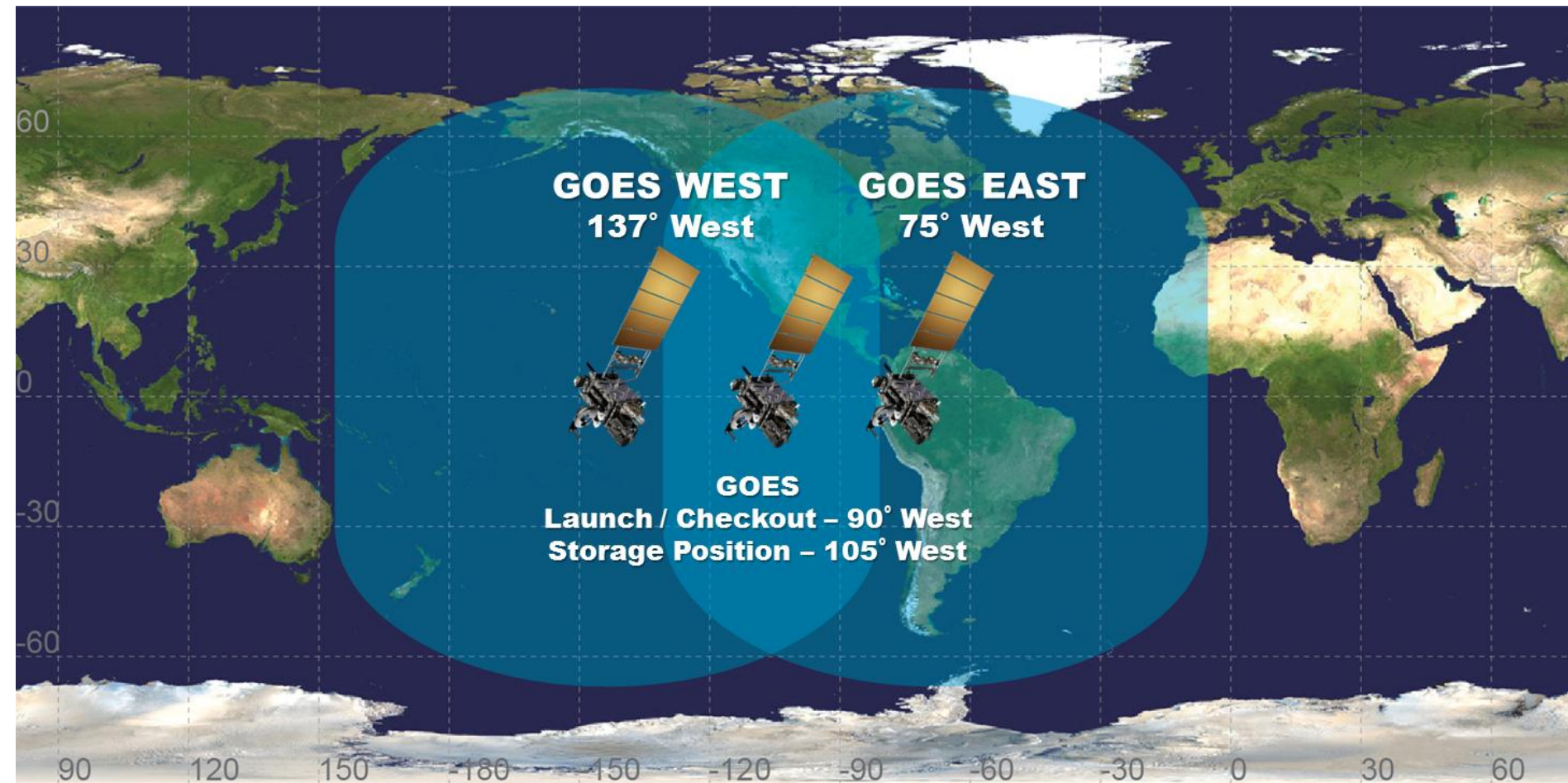
BUDGET
CUTS

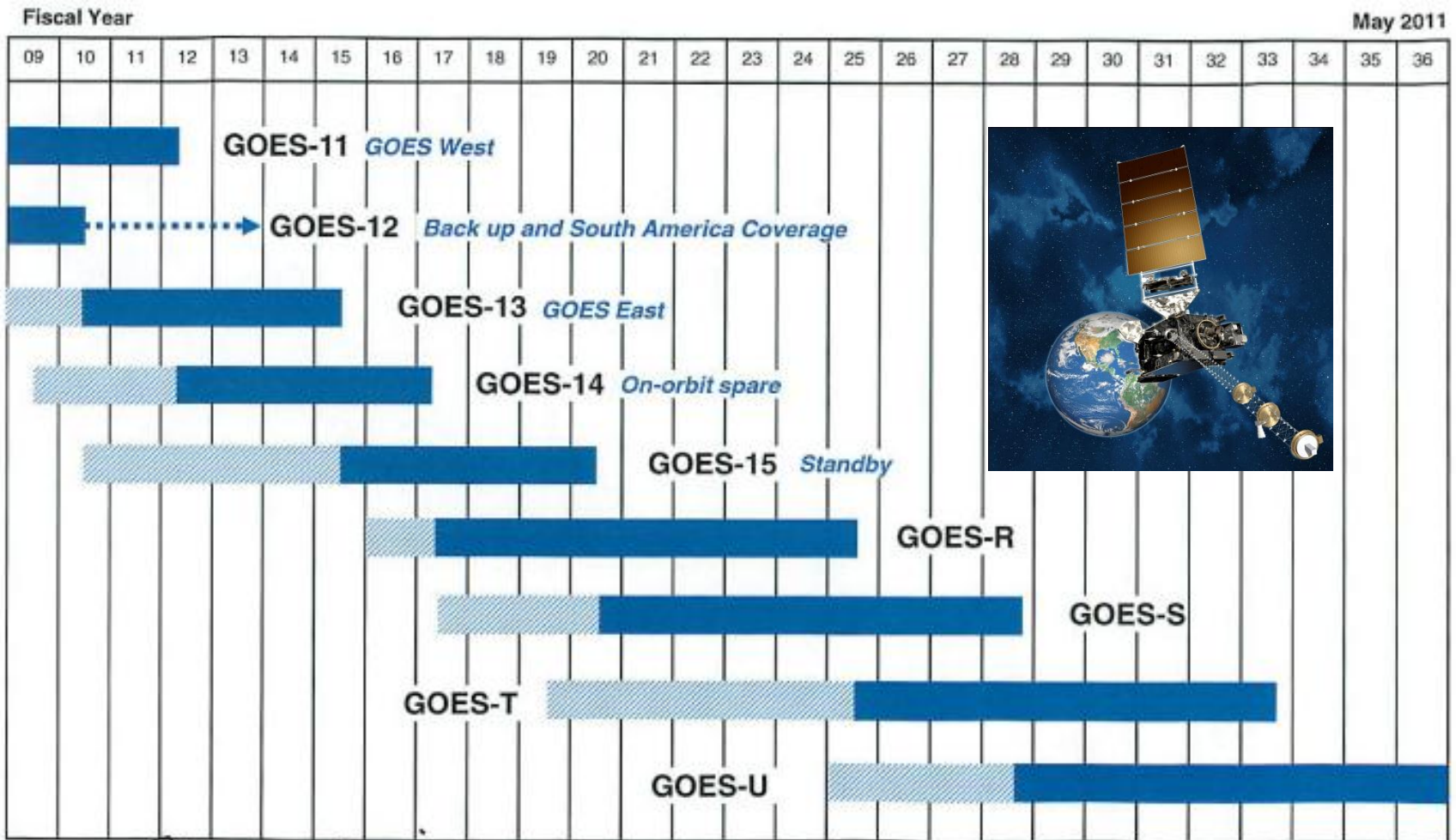
8-28-11

MORIN

The Miami Herald

GOES Fleet





Approved: Mary E. Kuczy

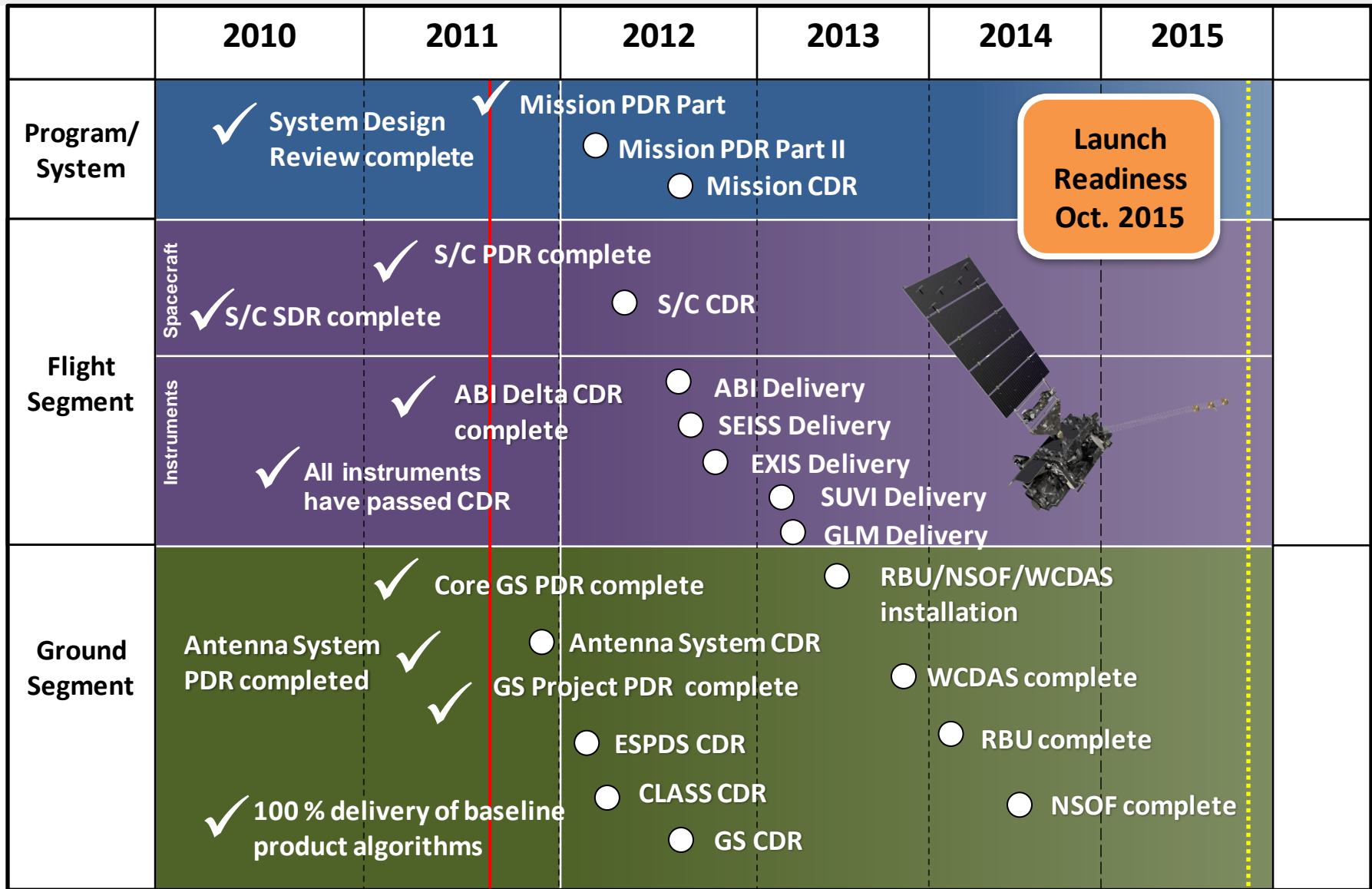
Assistant Administrator for
Satellite and Information Services

Signed on: 5/23/11

.....▶ Satellite is operational
beyond design life

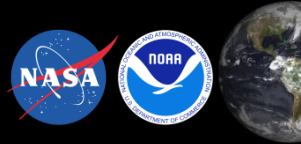
 Post Launch Test / On-orbit
storage
 Operational

GOES-R Milestones





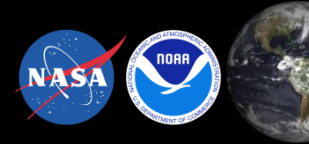
Program Updates



- Eliminated eGVAR (Emulated GOES Variable Data)
 - Program will work with users to transition directly to GOES Rebroadcast (GRB)
- GOES-R L band frequency shift down to 3.4MHz
 - Presidential Broadband Initiative
- Removed 31 new and reduced latency products from the Ground System Core Contract due to budget constraints
 - Products now defined as: baseline and future capabilities



Future Capability Products: Path Forward



- GOES-R working with Office of Satellite and Product Operations (OSPO) and the National Weather Service (NWS) on post launch product evolution/addition process
 - The algorithm development will complete, and the GOES-R AWG will deliver tested Algorithm Theoretical Basis Documents (ATBDs)
 - ATBD packages, including test data will be delivered on schedule
 - These materials are available to users at NOAA's discretion
 - NWS assessing its priorities for future product algorithms “as is” or as fused/integrated services and capabilities
- All data necessary to produce these future capability products are available to users
 - GOES-R produced data into Environmental Satellite Processing and Distribution System (ESPDS)/GOES-R Access Subsystem (GAS)
 - L-1b, calibration, spacecraft specific data, etc
 - Ancillary Data (external sources) into ESPDS/Ancillary Data Relay System (ADRS)



GOES-R Products



Baseline Products

Advanced Baseline Imager (ABI)	Geostationary Lightning Mapper (GLM)
Aerosol Detection (Including Smoke and Dust)	Lightning Detection: Events, Groups & Flashes
Aerosol Optical Depth (AOD)	
Clear Sky Masks	
Cloud and Moisture Imagery	
Cloud Optical Depth	
Cloud Particle Size Distribution	
Cloud Top Height	
Cloud Top Phase	
Cloud Top Pressure	
Cloud Top Temperature	
Derived Motion Winds	
Derived Stability Indices	
Downward Shortwave Radiation: Surface	
Fire/Hot Spot Characterization	
Hurricane Intensity Estimation	
Land Surface Temperature (Skin)	
Legacy Vertical Moisture Profile	
Legacy Vertical Temperature Profile	
Radiances	
Rainfall Rate/QPE	
Reflected Shortwave Radiation: TOA	
Sea Surface Temperature (Skin)	
Snow Cover	
Total Precipitable Water	
Volcanic Ash: Detection and Height	

Future Capabilities

Advanced Baseline Imager (ABI)

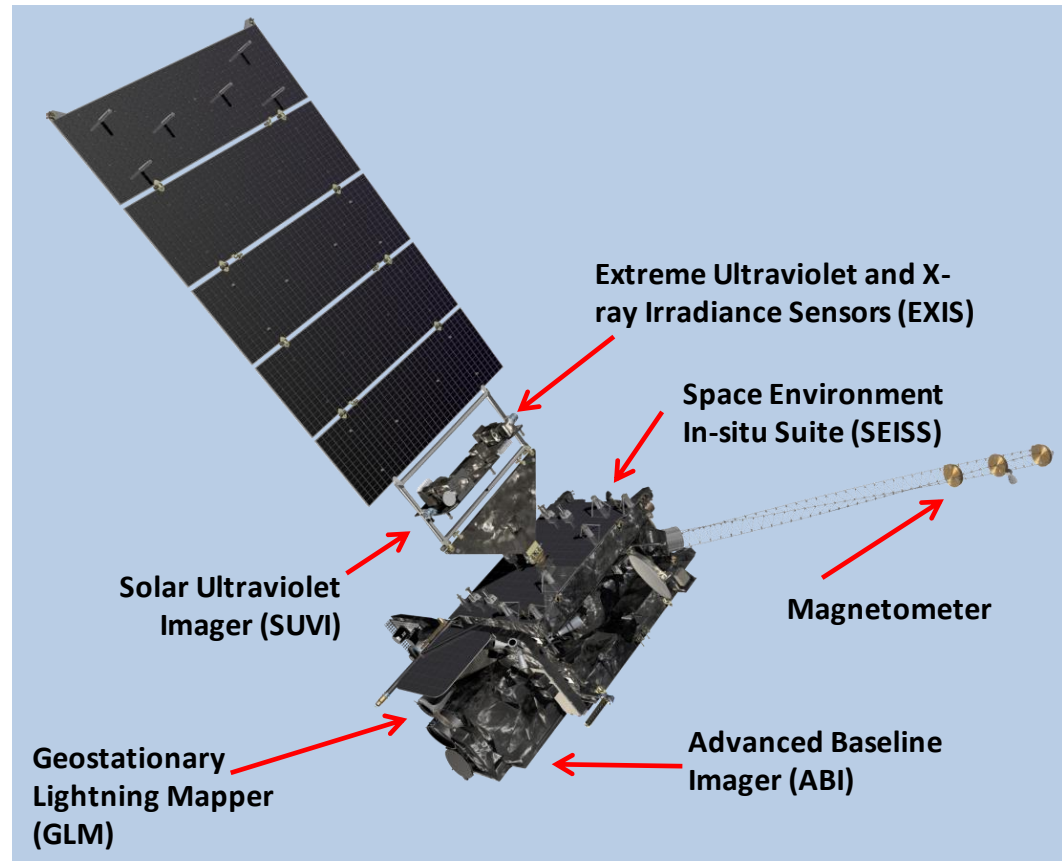
Absorbed Shortwave Radiation: Surface
Aerosol Particle Size
Aircraft Icing Threat
Cloud Ice Water Path
Cloud Layers/Heights
Cloud Liquid Water
Cloud Type
Convective Initiation
Currents
Currents: Offshore
Downward Longwave Radiation: Surface
Enhanced "V"/Overshooting Top Detection
Flood/Standing Water
Ice Cover
Low Cloud and Fog
Ozone Total
Probability of Rainfall
Rainfall Potential
Sea and Lake Ice: Age
Sea and Lake Ice: Concentration
Sea and Lake Ice: Motion
Snow Depth (Over Plains)
SO₂ Detection
Surface Albedo
Surface Emissivity
Tropopause Folding Turbulence Prediction
Upward Longwave Radiation: Surface
Upward Longwave Radiation: TOA
Vegetation Fraction: Green
Vegetation Index
Visibility

Specifications

- **Size** ~5.5 meters (from launch vehicle interface to top of ABI)
- **Mass** Satellite (spacecraft and payloads) dry mass <2800kg
- **Power Capacity** >4000W at end-of-life (includes accounting for limited array degradation)
- Spacecraft on-orbit life of 15 years with orbit East-West and North-South position maintained to within +/-0.1 degree
- 3-axis stabilized

Current Status

- Design activities progressing well
- Preliminary Design Review (PDR) held January 18-20, 2011
- Proceeding toward Critical Design Review (CDR) in April 2012



Lockheed Martin Space Systems Co (LMSSC) of Newtown, PA is primary contractor

Specifications

- 16 channel imager
- Measures radiances in the visible and near-infrared wavelengths
- Improves upon current capabilities in spectral information (3X), spatial coverage (4X), and temporal resolution (5X)
- Improves every product from current GOES Imager and will offer new products for severe weather forecasting, fire and smoke monitoring, volcanic ash advisories, and more

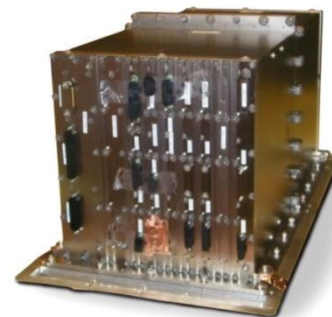
Current Status

- ABI delta Critical Design Review (CDR) held February 22-24, 2011
- Proto-Flight Model (PFM) fabrication is well underway

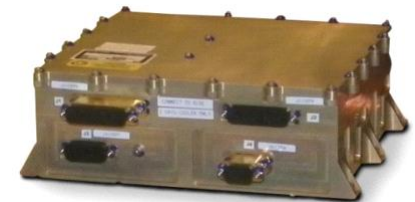
ITT Corporation of Ft. Wayne, IN is primary contractor



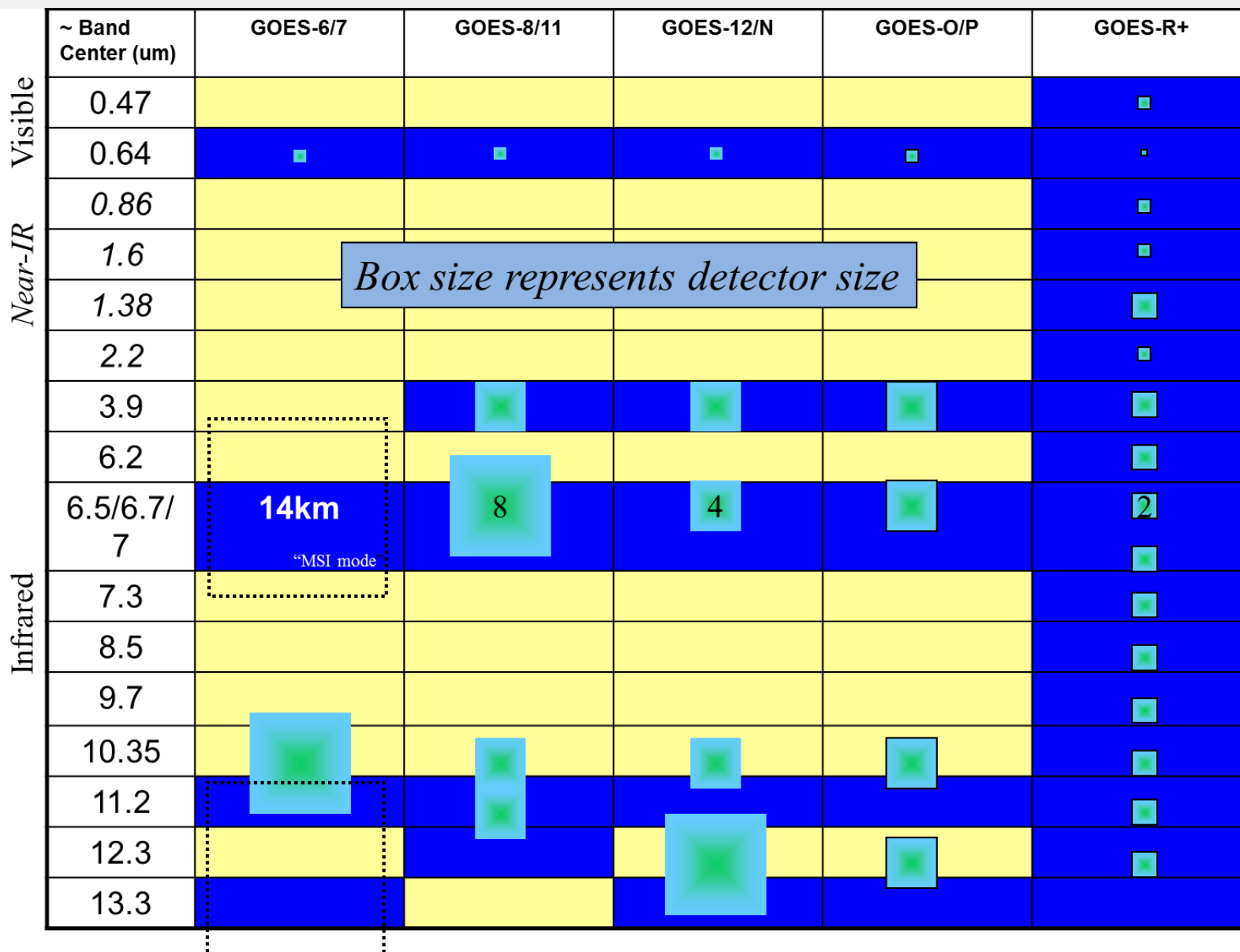
ABI Proto-Type Model (PTM)



Electronics Unit



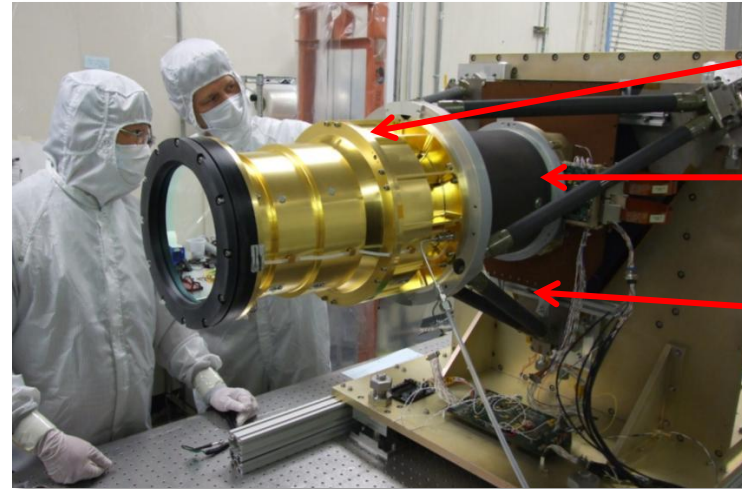
Cryocooler Control Electronics



- Continuously maps all (in-cloud and cloud-to-ground) lightning events
- Provides early indication of storm intensification and severe weather events; tornado warning lead time of 20 minutes or more
- CCD event detector
 - 777.4 nm wavelength
 - 2 ms frame rate
 - 7.7 Mbps downlink rate
- Near uniform spatial resolution
 - 8 km (nadir) – 14 km (edge of FOV)
 - 70-90% flash detection
- Product availability < 20 sec

- Flight fabrication is underway

Lockheed Martin Advanced Technology Corp
of Palo Alto, CA is primary contractor



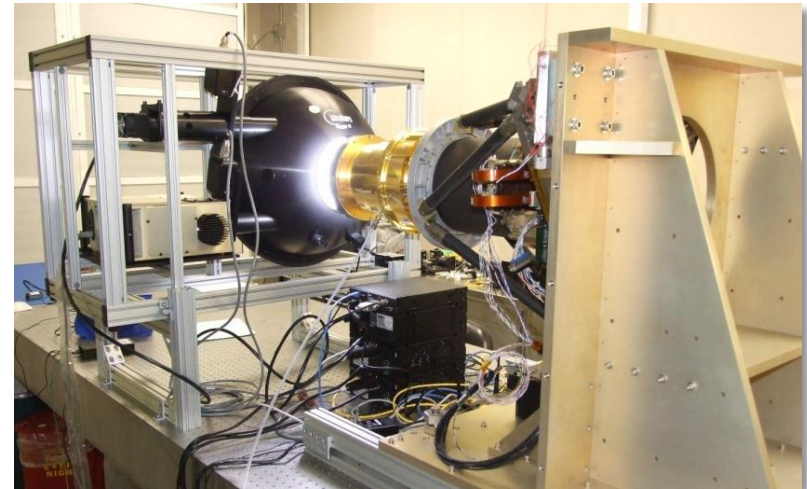
Optical Assembly

Metering tube

Sensor Unit

Mechanical

Support Structure



GLM in the calibration fixture

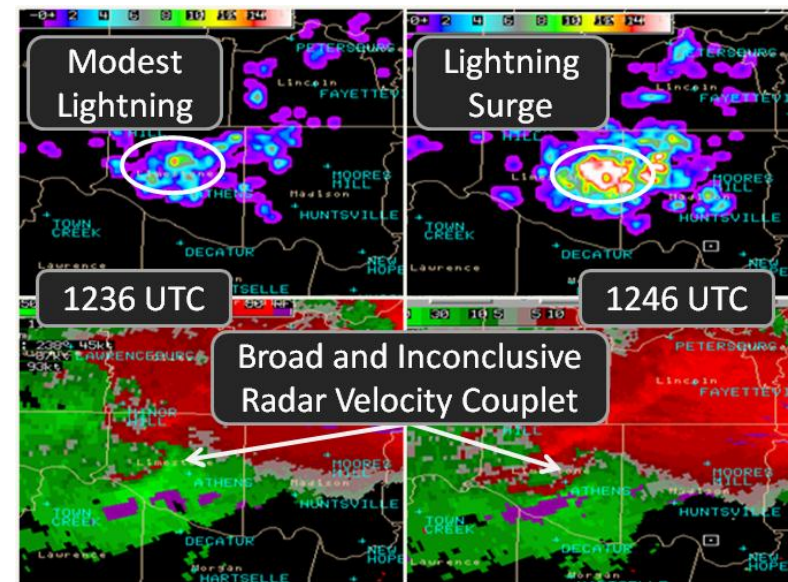
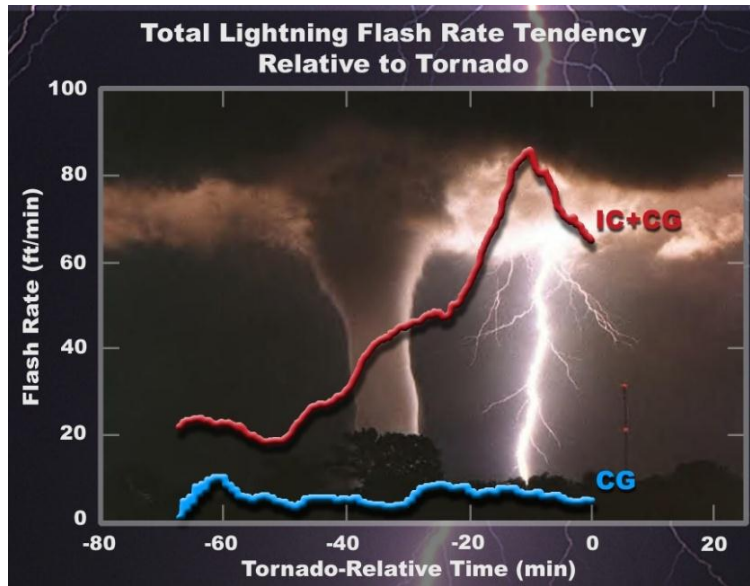


TABLE 3. Skill scores and average lead times using the sample set of 711 thunderstorms for both total lightning and CG lightning, correlating trends in lightning to severe weather.

	POD	FAR	CSI	HSS	lead time (all)	lead time (tornado)
Total lightning	79%	36%	55%	0.71	20.65 mins	21.32 mins

National Average for Tornado warning lead-time is only 13 minutes

Specifications

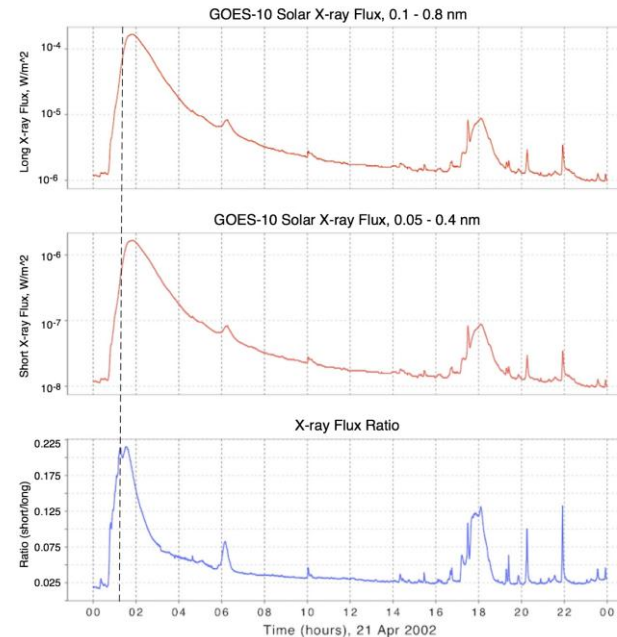
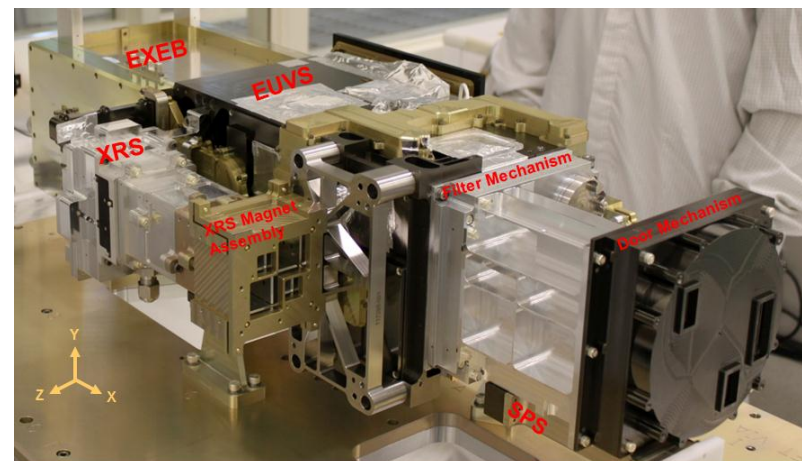
- XRS is designed to detect the beginning, duration, and magnitude of solar X-ray flares
- XRS provides input to models predicting severe impacts on satellites, astronauts, and airline passengers on polar routes, and provides input on possible impacts to power grid performance
- EUVS is designed to provide information on the full EUV spectrum that is critical to understanding and modeling the thermosphere and ionosphere

Current Status

- Flight fabrication is underway

Laboratory for Atmospheric and Space Physics of Boulder, CO is the primary contractor

Engineering Test Unit (ETU)



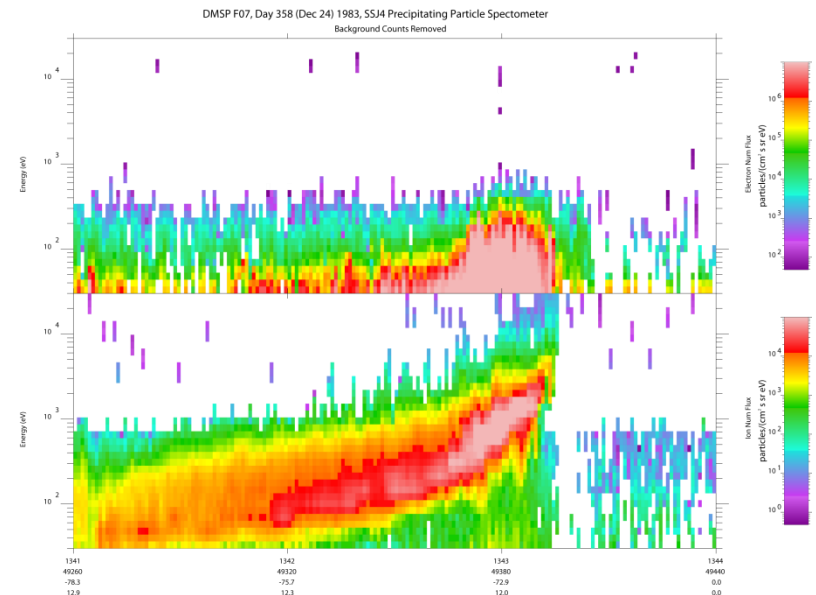
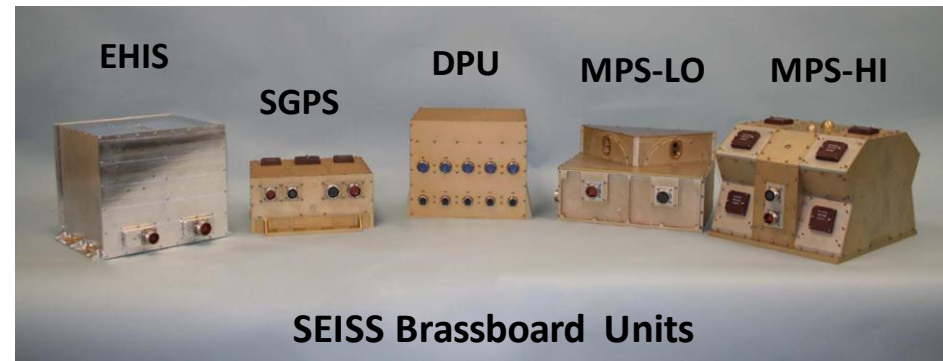
Specifications

- SEISS consists of energetic particle sensors that will monitor the proton, electron and alpha particle fluxes
- Knowledge of the near-Earth energetic particle environment is important in establishing the natural radiation hazard to humans at high altitudes and in space, as well as risk assessment and warning of radiation hazards to satellite systems
- Warnings of high flux episodes can mitigate damage to radio communications and navigation systems

Current Status

- Flight fabrication is underway

Assurance Technology Corporation of Carlisle, MA is the primary contractor



Cusp plume, 24 Dec 1983, 1341:00-1344:00 UT

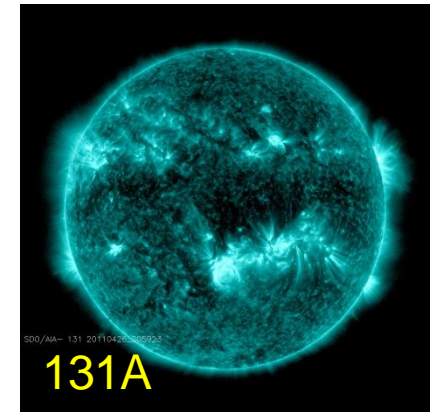
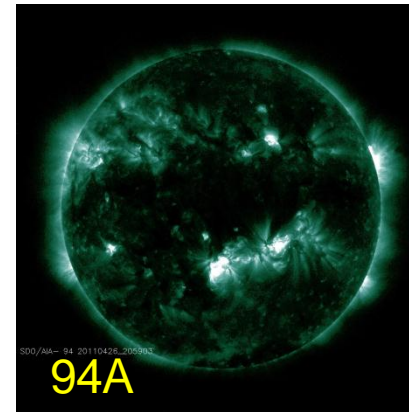
**SSJ/4: 0.03-30 keV (like MPS-Lo)
19 channels (vs. 15 for MPS-Lo)
Single FOV (vs. 12 for MPS-Lo)**

Specifications

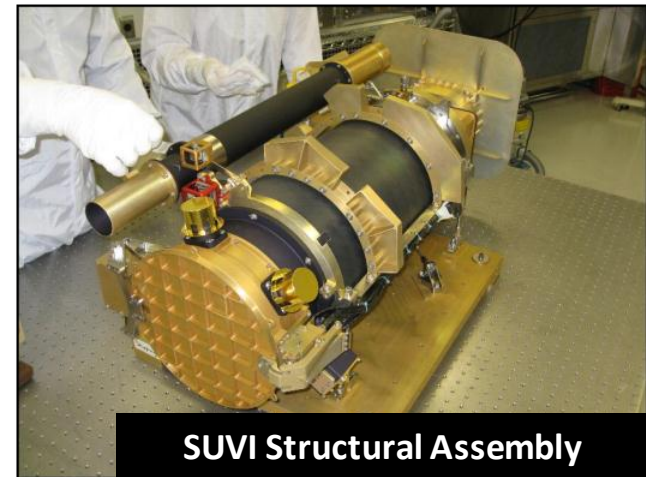
- SUVI measures extreme ultraviolet radiances from the sun to characterize active region complexity
- Provides full-disk images at six wavelengths (94A, 131A, 171A, 195A, 284A, 304A)
- Spatial and temporal sampling -10 second cadence for individual images, 2.5 arcsec square pixels, patrol sequence takes four minutes to cover the full dynamic range in all bands, with some repeats
- Locates coronal holes, flares, and coronal mass ejection source regions

Current Status

- Flight fabrication is underway



SDO/AIA 26-Apr-11 20:59:05.130
<http://sdownwww.lmsal.com/suntoday/#>

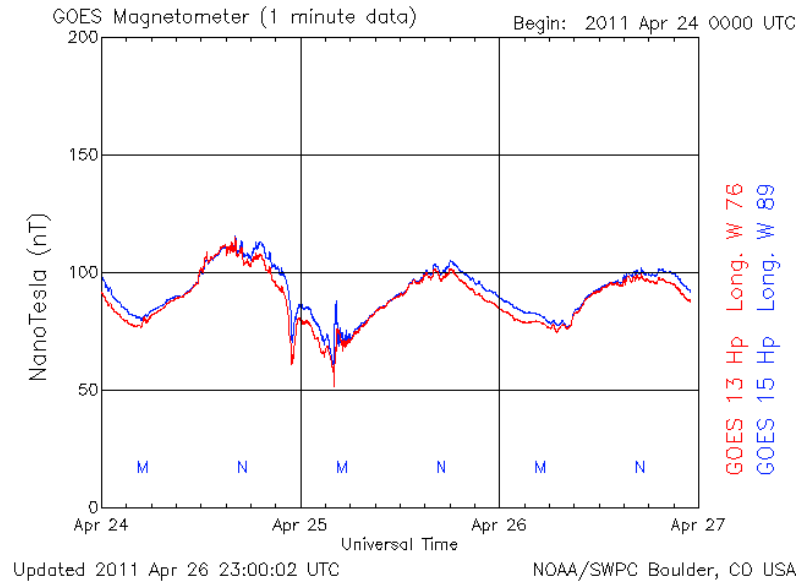


Lockheed Martin Advanced Technology Center of Palo Alto,
CA is the primary contractor



Specifications

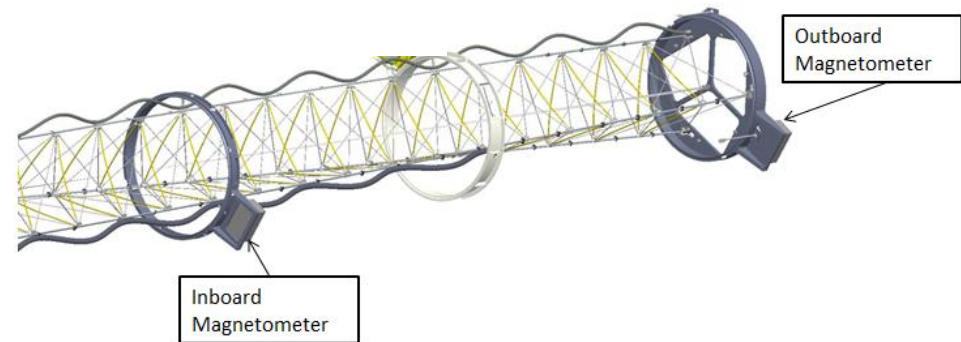
- The magnetometer measures the magnitude and direction of the Earth's ambient magnetic field
- The magnetometer provides a map of the space environment that controls charged particle dynamics in the outer region of the magnetosphere
- Magnetic field measurements provide information on the general level of geomagnetic activity, and permit detection of magnetopause crossings, sudden storm commencements, and substorms



The GOES Hp plot contains the 1-minute averaged parallel component of the magnetic field in nanoTeslas (nT), as measured at GOES-13 (W75) and GOES-15 (W89).

Current Status

- Completed Instrument PDR in February 2011
- Magnetometer Boom PDR completed in June 2011



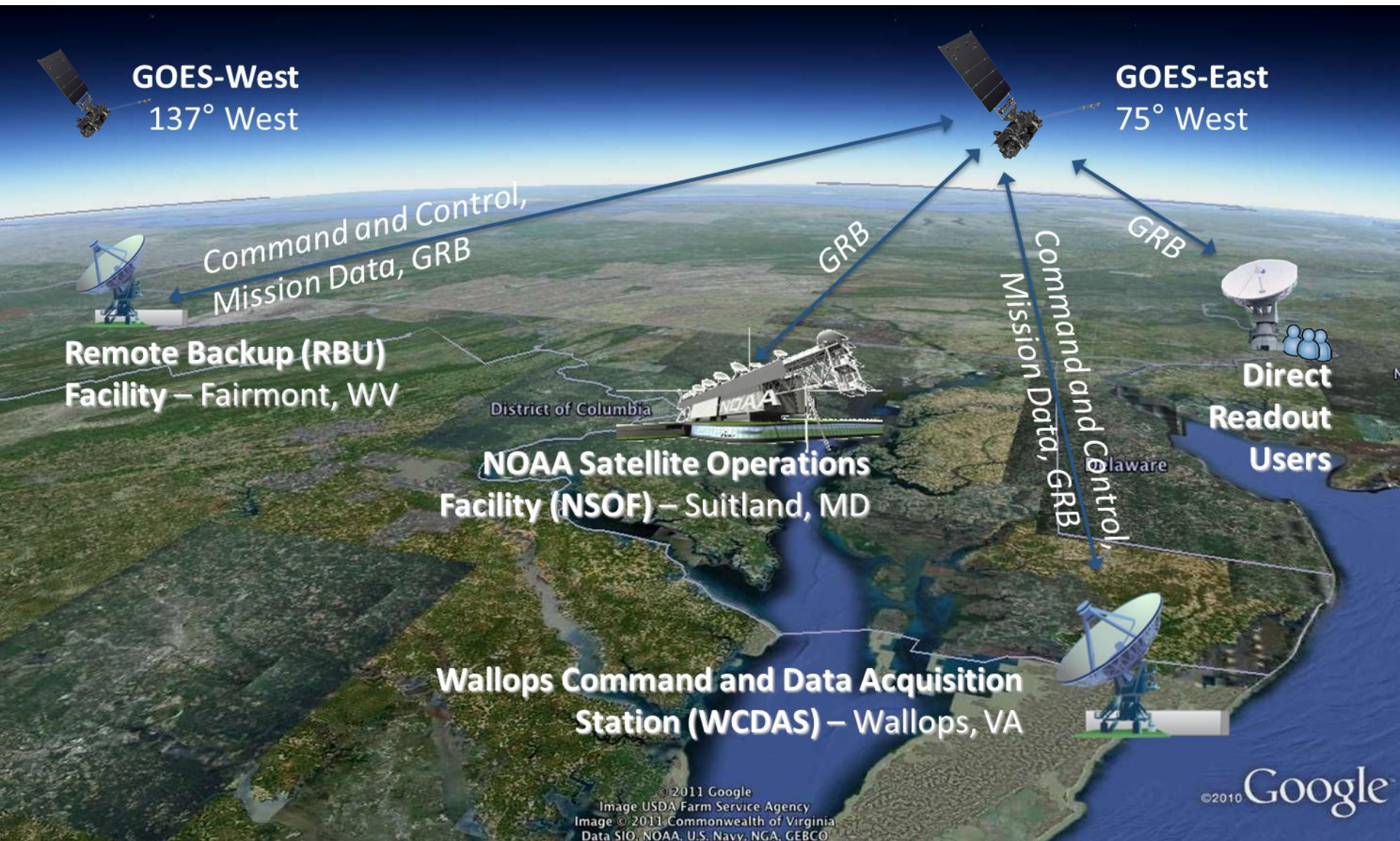
Lockheed Martin of Newtown, PA is the primary contractor



- GOES Rebroadcast (GRB)
 - GRB will contain the Level 1b data from each of the GOES-R Series instruments and is the GOES-R Series version of today's GOES Variable format (GVAR).
- Information Network (HRIT/EMWIN)
 - New high data rate (400 Kbps)
 - Combination of today's LRIT (Low Rate Information Transmission) and EMWIN services;
 - Delivers selected imagery, charts, other environmental data products, and text messages (NWS Watches and Warnings) to hemispheric users.
- Data Collection System (DCS)
 - GOES-R spacecraft relay data transmissions for nearly 30,000 in-situ environmental data platforms from across the hemisphere.
 - GOES-R will support 300 bps, 1200 bps, and CDMA platforms.
- Search and Rescue Satellite Aided Tracking (SARSAT)
 - All GOES-R satellites support the SARSAT system by relaying distress signals from 406 MHz emergency beacons.



Ground Segment Architecture





**NOAA Satellite Operations Facility
(NSOF)
Suitland, Maryland**



**Wallops Command & Data
Acquisition Station (WCDAS),
Wallops, VA**



**Remote Backup (RBU)
Fairmont, WV**

- Command/Control (C&C)
- Archive
- Ancillary Data Relay System
- L2+ data processing

- Telemetry, Tracking, and Command (TT&C)
- Backup Command/Control
- GRB production and broadcast

- TT&C
- C&C
- GRB production and broadcast
- Select backup L2+ data processing

- GS Project PDR completed 6/11
- GS CDR to be held 7/12

- Antenna System PDR held 4/11
- Antenna System CDR 12/11

- RBU site preparations underway

Algorithm Development



Calibration, Validation, and Verification



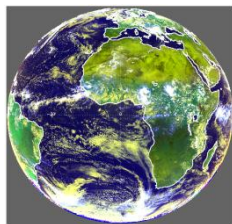
Algorithm Sustainment and Product Tailoring

"Real" ABI PROXY Data Sources

Current GOES



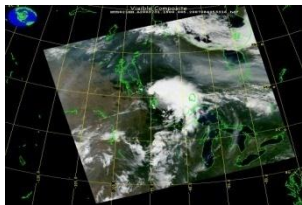
Meteosat/
SEVIRI



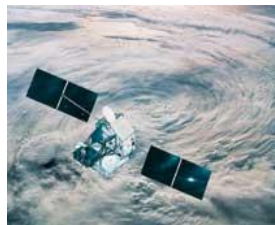
AVHRR



MODIS

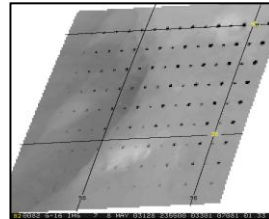


TRMM/LIS

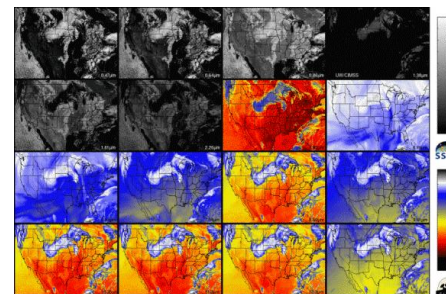


Lightning Mapping

3.9um (for fires)



"Simulated" ABI Proxy Data Sources

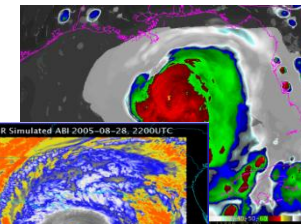


ABI band data for 2005 June 04 15:00 UTC

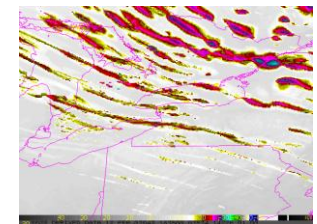
(FD, CONUS, Meso)

Case Studies

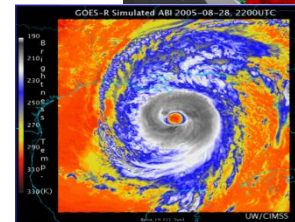
10.35um (Hurricane Lili)



10.35um (Lake Effect Snow)



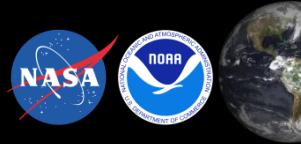
11.2 um (Hurricane Katrina)



AWG Proxy and Product Application Teams have assembled a wide variety of instrument proxy and simulated datasets to use for algorithm development, testing, and validation activities



GOES Rebroadcast (GRB)



Data Transition

- Full set of level 1b products, including data from all ABI channels and the other GOES-R instruments (GLM, MAG, SEISS, SUVI, EXIS)
- GOES users **must** acquire new hardware, or upgrade their existing GVAR systems in order to receive GOES-R data
- Existing GVAR systems will need new receiver antenna hardware, as well as new signal demodulation hardware and computer hardware so that they are able to handle the large amount of GOES-R data
- CLASS will provide permanent archive for GOES-R data as part of its mission to be the single data repository for NOAA

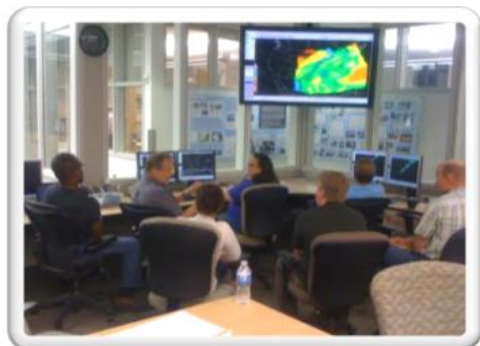


-
- May 2011
content
d June 2011
(ESRsatellite)

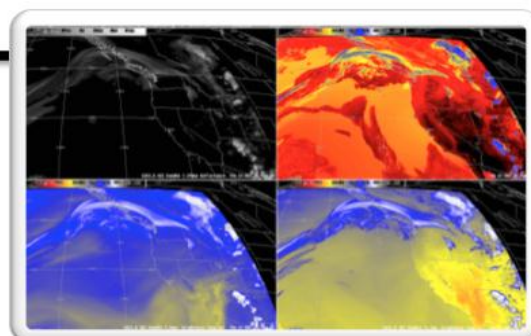
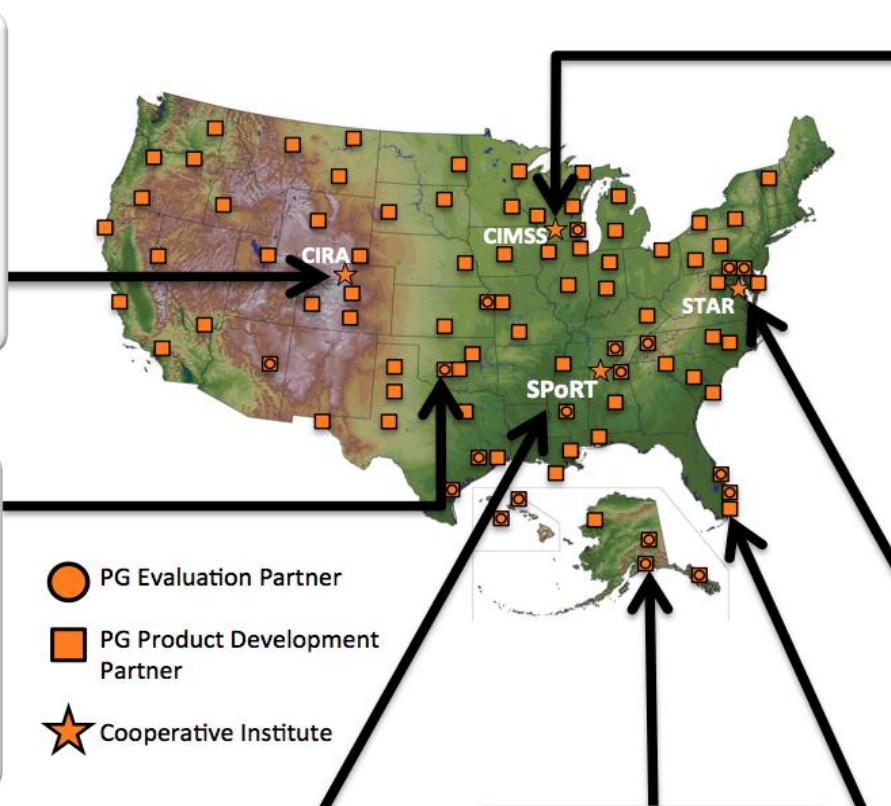
The GOES-R Proving Ground



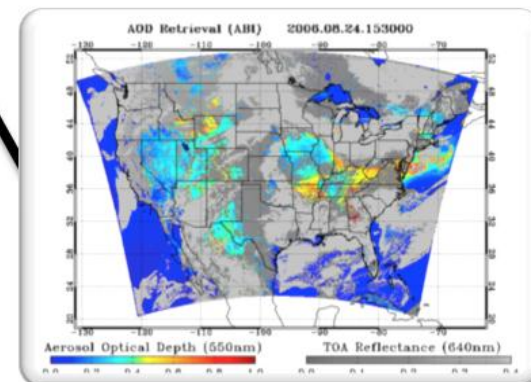
CIRA - Ft. Collins, CO
ABI Simulated Natural Color



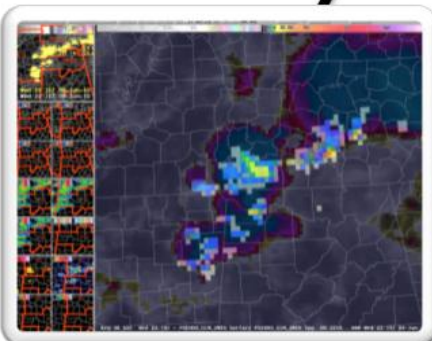
SPC - Oklahoma City, OK
Nearcast Training at the Hazardous Weather Testbed



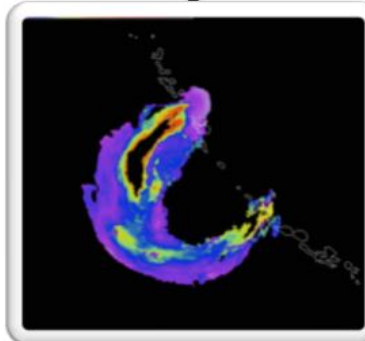
CIMSS - Madison, WI
Simulated ABI Bands



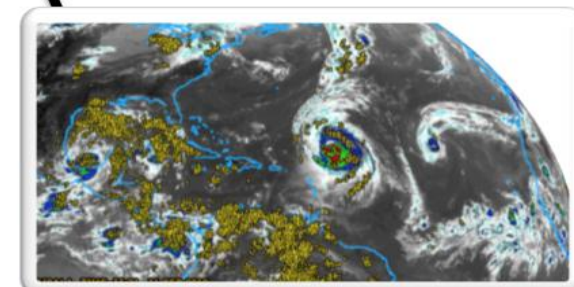
STAR - Camp Springs, MD
Aerosol Optical Depth Product



SPoRT - Huntsville, AL
GLM Lightning Flash Density



AFC - Anchorage, AK
Volcanic Ash Product

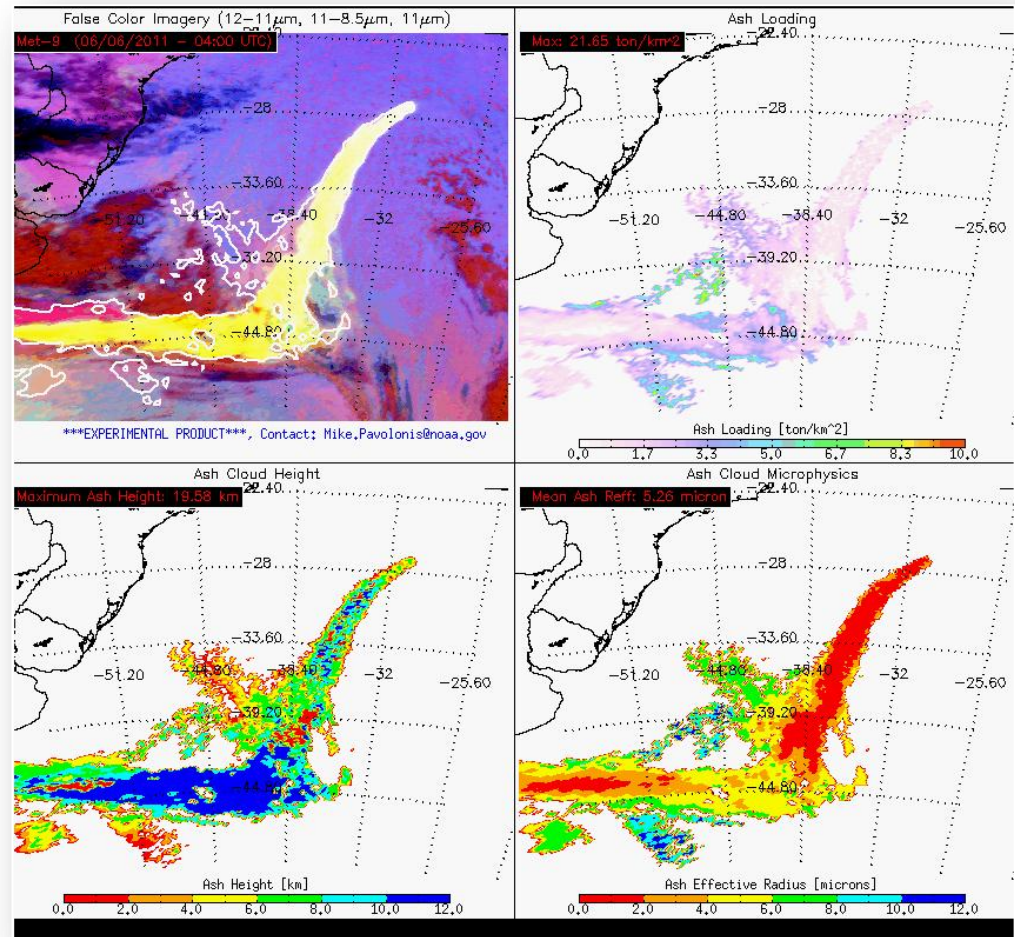


NHC - Miami, FL Rapid Intensification Index

Volcanic Ash Product Suite

Baseline Product

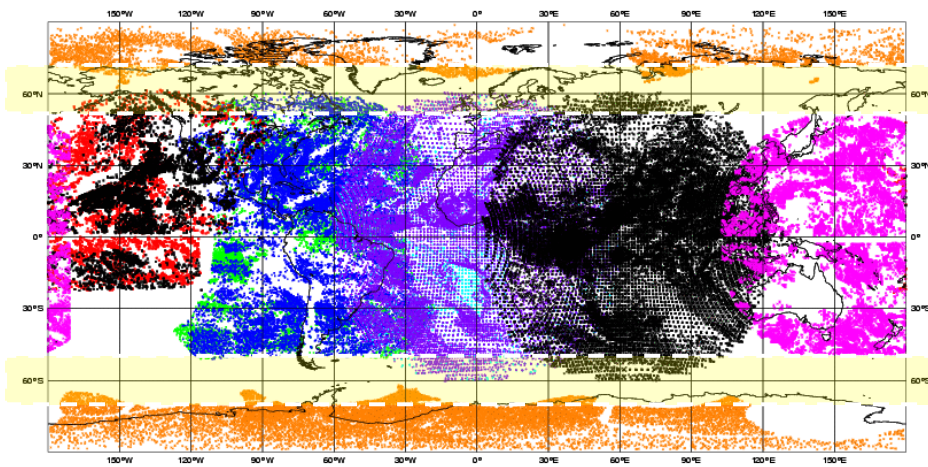
- Chile's Puyehue-Cordón Caulle Volcano erupted on June 4, 2011, forming a tall ash plume above the Andes Mountains
- The GOES-R Proving Ground provides near real-time volcanic ash retrieval products (using Meteosat SEVIRI data as a proxy for the GOES-R Advanced Baseline Imager) to identify a significant volcanic ash plume emerging over the Atlantic Ocean impacting aviation operations with many cancelled flights.
- Similar data was provided by STAR to the London Volcanic Ash Advisory Center (VAAC) during the eruption of Eyjafjallajökull in Iceland in May 2010.



Courtesy of Mike Pavolonis – NESDIS/STAR

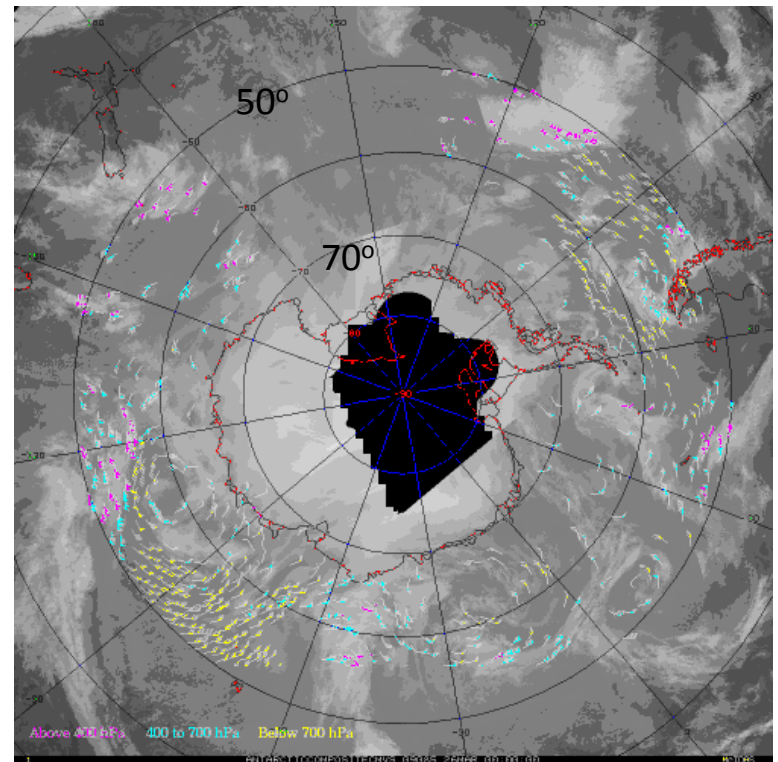
High Latitude Atmospheric Motion Vectors

Geostationary satellites provide Atmospheric Motion Vectors (AMV) equatorward of $\sim 60^\circ$ latitude; polar satellites provide AMVs poleward of $\sim 70^\circ$ latitude.



Developing novel ways to fill this gap is the next step in providing complete wind coverage for NWP applications.

Multiple satellite data are blended and used for AMV generation. The images are composites of the Geo (GOES, Meteosat-7 and -9, FY-2C, MTSAT-1R, Kalpana-1) and Leo satellites (NOAA-15 through NOAA-19, Metop-A, NASA's Terra and Aqua).



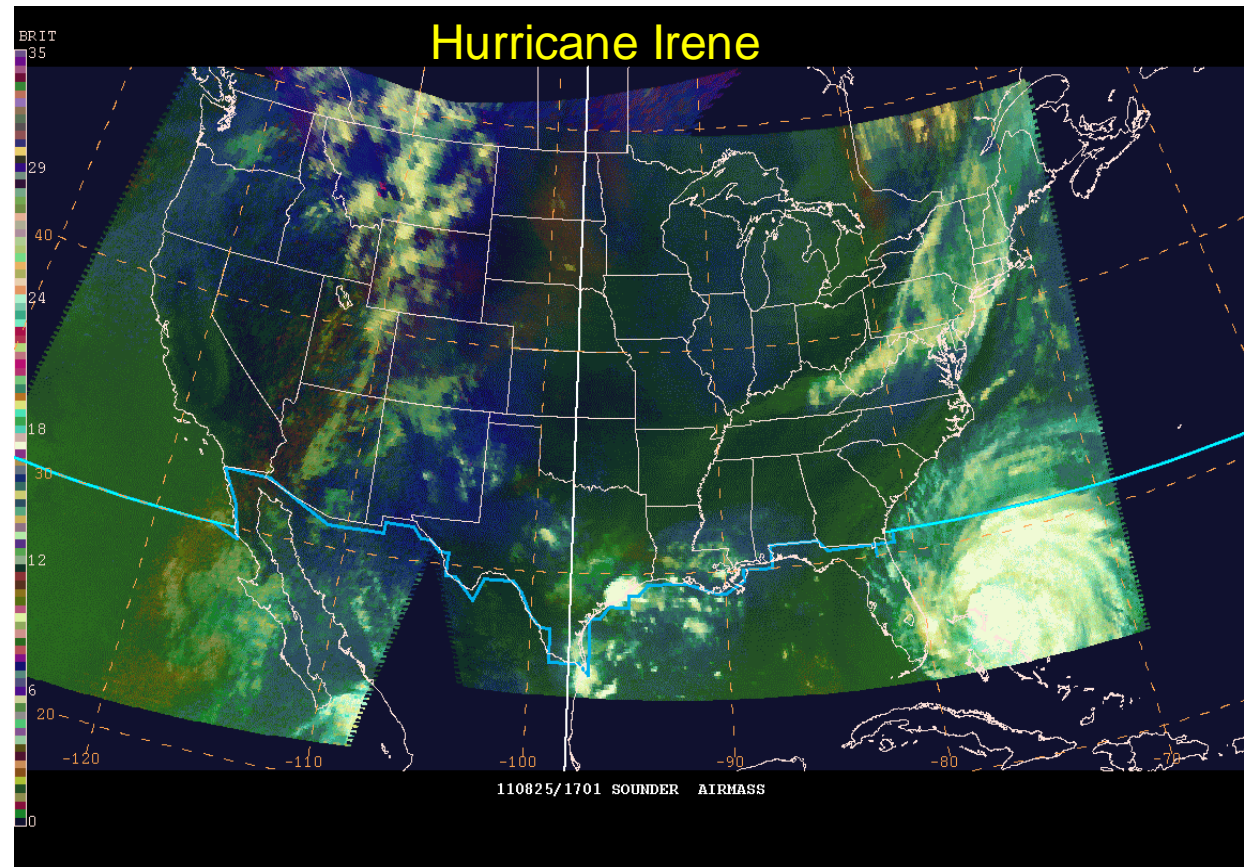
Animation: Example of winds from composite GEO/LEO satellite data over Antarctica.

Future Capability

“The RGB airmass and dust products were very useful in showing that the pre-Irene disturbance was going to have dry air issues initially. I think this helped us give the system a low chance of development in the early tropical weather outlooks.”

Jack Beven, NHC

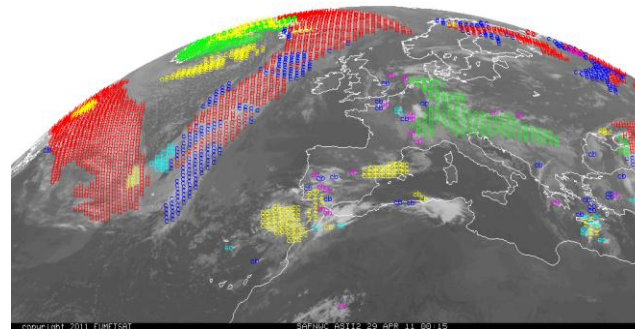
As the hurricane is approaching Cape Lookout, NC, the RGB product shows evidence of synoptic-scale dry air on the south-southeast side of the circulation. Synoptic-scale dry air is present to the northwest on the periphery of the storm. This dry air is caught in the southwest inflow channel, effectively cutting off convective development by introducing stably stratified air.



From John Knaff/CIRA, NASA SPoRT ,and Michael Folmer (CICS Satellite Champion at HPC/OPC/SAB)

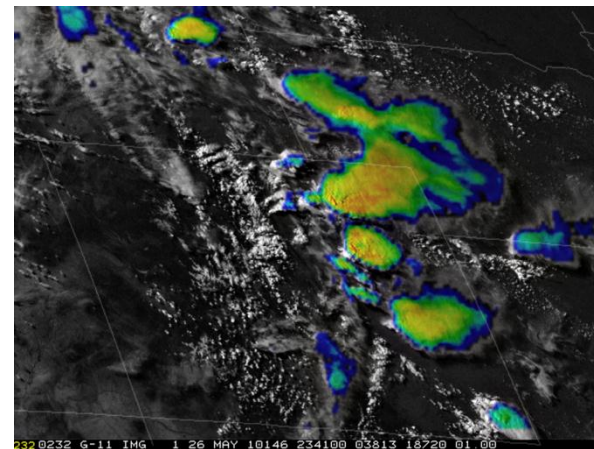
GOES-R Visiting Scientist Program

- Ama Ba (NWS MDL): Automatic Satellite Image Interpretation Product: “first-hand information about the use and benefits of the NWC SAF products for a potential use in NWS operations.”



Symbol:	Conceptual Model:
SAT + NWP:	
w (red)	warm front
c (blue)	cold front
c (red)	cold front in warm air advection
~ (magenta)	wave
~ (red)	developing wave
~ (green)	upper wave
o (green)	occlusion
DI (cyan)	dry intrusion
ec (cyan)	enhanced cumulus
m,cb (blue)	MCS, Cb (decaying stage, ● = embedded)
m,cb (yellow)	MCS, Cb (mature stage, ● = embedded)
m,cb (magenta)	MCS, Cb (mature stage, ● = embedded)
co (yellow)	comma cloudiness
L (yellow)	lee cloudiness
ji (yellow)	front intensification in left exit region of a Jet Streak
ul (yellow)	upper level low
z (yellow)	cold air cloudiness
F (yellow)	fibre

- Dan Lindsey (NESDIS STAR): “Dr. Setvak introduced the Sandwich Product. This product allows one to easily co-locate various cloud-top features (overshooting tops, plumes, gravity waves, etc.) with the associated brightness temperature features, such as cold and warm portions of a storm top, or BT minima...The higher resolution data available with GOES-R will greatly improve this product.”



Example of a “sandwich” product, in which a GOES-11 color-enhanced 10.7 μm image is blended with the corresponding visible image, from 26 May 2010 over Colorado. A number of supercell thunderstorms are active at this time. The warmer colors (red, orange) represent colder brightness temps.

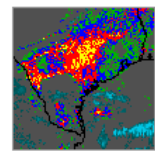
Training and Education



Online Training Modules

- GOES-R: Benefits of Next-Generation Environmental Monitoring (COMET)
- GOES-R 101
- Satellite Hydrology and Meteorology for Forecasters (SHyMet)
- SPoRT product training modules
- Commerce Learning Center

TRAINING



GOES Fog Depth
[Download](#) (for NWS users)
[Launch](#) in browser
[\(user guide\)](#)


This training module focuses on the use of the Fog Depth product within the GOES Aviation suite provided through a collaboration between SPoRT and NESDIS. The use of this product along with the Low Cloud Base product is demonstrated in support of aviation forecasts of ceiling and visibility. This module takes 16 minutes to complete and requires the flash plug-in. (May 2008)

Printed Materials

- GOES-R Fact Sheets (17)
- GOES-R Tri-fold



GOES-R 101



Bernie Connell¹, Timothy J. Schmit^{2,3}, Jim Gurka⁵,
 Steve Goodman⁵, Don Hillger^{2,4}, Steven Hill⁶,
 And many other contributors

GOES-R Program in cooperation with
 Satellite Hydrology and Meteorology (SHyMet) Forecasters Course

¹ Cooperative Institute for Research in the Atmosphere, Colorado State University
² NOAA/NESDIS Satellite Applications Research
³ Advanced Satellite Products Branch
⁴ Regional and Mesoscale Meteorology Branch

⁵ NOAA/NESDIS/OSD GOES-R Program Office
⁶ NOAA/NWS Space Weather Prediction Center
⁷ Cooperative Institute for Meteorological Studies, University of Wisconsin-Madison

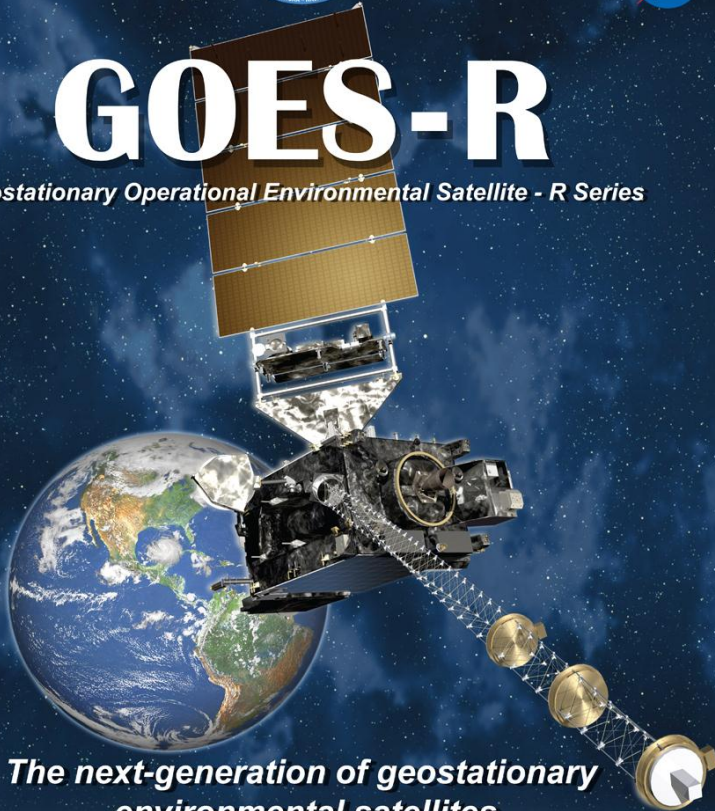
Outreach Projects (with NWSFOs):

- COMET will reach out to the GOES-R Proving Ground Partners and connect them with university faculty to use current and prototype data products for the purpose of building a bridge from products that are currently available to those that will become available when GOES-R is launched.



GOES-R

Geostationary Operational Environmental Satellite - R Series



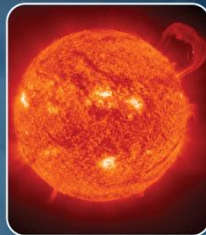
The next-generation of geostationary environmental satellites



Advanced imaging
for accurate forecasts



Real-time mapping
of lightning activity



Improved monitoring
of solar activity

Spacecraft image courtesy of Lockheed Martin

Thank you!

Any ???

For more information
visit www.goes-r.gov



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